# English

# for the Students of

# The Internet

by:

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# Part 1

# Information Technology (IT)

**Information technology** (IT) is the application of computers and telecommunications equipment to store, retrieve, transmit and manipulate data, often in the context of a business or other enterprise. The term is commonly used as a synonym for computers and computer networks, but it also encompasses other information distribution technologies such as television and telephones. Several industries are associated with information technology, such as computer hardware, software, electronics, semiconductors, internet, telecom equipment, e-commerce and computer services.

In a business context, the Information Technology Association of America has defined information technology as "the study, design, development, application, implementation, support or management of computer-based information systems". The responsibilities of those working in the field include network administration, software development and installation, and the planning and management of an organization's technology life cycle, by which hardware and software are maintained, upgraded and replaced.

Humans have been storing, retrieving, manipulating and communicating information since the Sumerians in Mesopotamia developed writing in about 3000 BC, but the term *information technology* in its modern sense first appeared in a 1958 article published in the *Harvard Business Review*; authors Harold J. Leavitt and Thomas L. Whisler commented that "the new technology does not yet have a single established name. We shall call it information technology (IT)." Their definition consists of three categories such as techniques for processing, the application of statistical and mathematical methods to decision-making and the simulation of higher-order thinking through computer programs.

Based on the storage and processing technologies employed, it is possible to distinguish four distinct phases of IT development: pre-mechanical (3000 BC – 1450 AD), mechanical (1450–1840), electromechanical (1840–1940) and electronic (1940–present).

# Contents:

**Information Technology**

# History of computer technology

Devices have been used to aid computation for thousands of years, probably initially in the form of a tally stick. The Antikythera mechanism, dating from about the beginning of the first century BC, is generally considered to be the earliest known mechanical analog computer; it is also the earliest known geared mechanism. Comparable geared devices did not emerge in Europe until the 16th century, and it was not until 1645 that the first mechanical calculator capable of performing the four basic arithmetical operations was developed.

Electronic computers, using either relays or valves, began to appear in the early 1940s. The electromechanical Zuse Z3, completed in 1941, was the world's first programmable computer, and by modern standards one of the first machines that could be considered a complete computing machine. Colossus, developed during the Second World War to decrypt German messages was the first electronic digital computer. Although it was programmable, it was not general-purpose, being designed to perform only a single task. It also lacked the ability to store its program in memory; programming was carried out using plugs and switches to alter the internal wiring. The first recognisably modern electronic digital stored-program computer was the Manchester Small-Scale Experimental Machine (SSEM), which ran its first program on 21 June 1948.

The development of transistors in the late 1940s at Bell Laboratories allowed a new generation of computers to be designed with greatly reduced power consumption. The first commercially available stored-program computer, the Ferranti Mark 1, contained 4050 valves and had a power consumption of 25 kilowatts. By comparison the first transistorised computer, developed at the University of Manchester and operational by November 1953, consumed only 150 watts in its final version.

# Data storage

Early electronic computers such as Colossus made use of punched tape, a long strip of paper on which data was represented by a series of holes, a technology now obsolete. Electronic data storage, which is used in modern computers, dates from the Second World War, when a form of delay line memory was developed to remove the clutter from radar signals, the first practical application of which was the mercury delay line. The first random-access digital storage device was the Williams tube, based on a standard cathode ray tube, but the information stored in it and delay line memory was volatile in that it had to be continuously refreshed, and thus was lost once power was removed. The earliest form of non-volatile computer storage was the magnetic drum, invented in 1932 and used in the Ferranti Mark 1, the world's first commercially available general-purpose electronic computer.

IBM introduced the first hard disk drive in 1956, as a component of their 305 RAMAC computer system. Most digital data today is still stored magnetically on hard disks, or optically on media such as CD-ROMs. Until 2002 most information was stored on analog devices, but that

year digital storage capacity exceeded analog for the first time. As of 2007 almost 94% of the data stored worldwide was held digitally: 52% on hard disks, 28% on optical devices, and 11% on digital magnetic tape. It has been estimated that the worldwide capacity to store information on electronic devices grew from less than 3 exabytes in 1986 to 295 exabytes in 2007, doubling roughly every 3 years.

# Databases

Database management systems emerged in the 1960s to address the problem of storing and retrieving large amounts of data accurately and quickly. One of the earliest such systems was IBM's Information Management System (IMS), which is still widely deployed more than 40 years later. IMS stores data hierarchically, but in the 1970s Ted Codd proposed an alternative relational storage model based on set theory and predicate logic and the familiar concepts of tables, rows and columns. The first commercially available relational database management system (RDBMS) was available from Oracle in 1980.

All database management systems consist of a number of components that together allow the data they store to be accessed simultaneously by many users while maintaining its integrity. A characteristic of all databases is that the structure of the data they contain is defined and stored separately from the data itself, in a database schema.

The extensible markup language (XML) has become a popular format for data representation in recent years. Although XML data can be stored in normal file systems, it is commonly held in relational databases to take advantage of their "robust implementation verified by years of both theoretical and practical effort". As an evolution of the Standard Generalized Markup Language (SGML), XML's text-based structure offers the advantage of being both machine and human-readable.

# Data retrieval

The relational database model introduced a programming-language independent Structured Query Language (SQL), based on relational algebra.

The terms "data" and "information" are not synonymous. Anything stored is data, but it only becomes information when it is organised and presented meaningfully. Most of the world's digital data is unstructured, and stored in a variety of different physical formats even within a single organization. Data warehouses began to be developed in the 1980s to integrate these disparate stores. They typically contain data extracted from various sources, including external sources such as the Internet, organised in such a way as to facilitate decision support systems (DSS).

## Data transmission

Data transmission has three aspects: transmission, propagation, and reception. It can be broadly categorized as broadcasting, in which information is transmitted unidirectionally downstream, or telecommunications, with bidirectional upstream and downstream channels.

XML has been increasingly employed as a means of data interchange since the early 2000s, particularly for machine-oriented interactions such as those involved in web-oriented protocols such as SOAP, describing "data-in-transit rather than ... data-at-rest". One of the challenges of such usage is converting data from relational databases into XML Document Object Model (DOM) structures.

## Data manipulation

Hilbert and Lopez identify the exponential pace of technological change (a kind of Moore's law): machines' application-specific capacity to compute information per capita roughly doubled every 14 months between 1986 and 2007; the per capita capacity of the world's general-purpose computers doubled every 18 months during the same two decades; the global telecommunication capacity per capita doubled every 34 months; the world's storage capacity per capita required roughly 40 months to double (every 3 years); and per capita broadcast information has doubled every 12.3 years.

Massive amounts of data are stored worldwide every day, but unless it can be analysed and presented effectively it essentially resides in what have been called data tombs: "data archives that are seldom visited".To address that issue, the field of data mining – "the process of discovering interesting patterns and knowledge from large amounts of data"– emerged in the late 1980s.

## Academic perspective

In an academic context, the Association for Computing Machinery defines IT as "undergraduate degree programs that prepare students to meet the computer technology needs of business, government, healthcare, schools, and other kinds of organizations .... IT specialists assume responsibility for selecting hardware and software products appropriate for an organization, integrating those products with organizational needs and infrastructure, and installing, customizing, and maintaining those applications for the organization's computer users."

# Ethical perspective

The field of information ethics was established by mathematician Norbert Wiener in the 1940s. Some of the ethical issues associated with the use of information technology include:

Breaches of copyright by those downloading files stored without the permission of the copyright holders

- Employers monitoring their employees' emails and other Internet usage
- Unsolicited emails
- Hackers accessing online databases
- Web sites installing cookies or spyware to monitor a user's online activities

# Commercial and Employment perspective

The business value of information technology lies in the automation of business processes; provision of information for decision making, connecting businesses with their customers, and the provision of productivity tools to increase efficiency.

Worldwide IT spending forecast (billions of U.S. dollars)

| Category | 2012 spending | 2013 spending |
|---|---|---|
| Devices | 627 | 666 |
| Data center systems | 141 | 147 |
| Enterprise software | 278 | 296 |
| IT services | 881 | 927 |
| Telecom services | 1,661 | 1,701 |
| Total | 3,588 | 3,737 |

# Part 2

# The Internet

The **Internet** is a global system of interconnected computer networks that use the standard Internet protocol suite (TCP/IP) to serve several billion users worldwide. It is a *network of networks* that consists of millions of private, public, academic, business, and government networks, of local to global scope, that are linked by a broad array of electronic, wireless, and optical networking technologies. The Internet carries an extensive range of information resources and services, such as the inter-linked hypertext documents of the World Wide Web (WWW), the infrastructure to support email, and peer-to-peer networks.

Most traditional communications media including telephone, music, film, and television are being reshaped or redefined by the Internet, giving birth to new services such as voice over Internet Protocol (VoIP) and Internet Protocol television (IPTV). Newspaper, book, and other print publishing are adapting to website technology, or are reshaped into blogging and web feeds. The Internet has enabled and accelerated new forms of human interactions through instant messaging, Internet forums, and social networking. Online shopping has boomed both for major retail outlets and small artisans and traders. Business-to-business and financial services on the Internet affect supply chains across entire industries.

The origins of the Internet reach back to research commissioned by the United States government in the 1960s to build robust, fault-tolerant communication via computer networks. While this work, together with work in the United Kingdom and France, led to important precursor networks, they were not the Internet. There is no consensus on the exact date when the modern Internet came into being, but sometime in the early to mid-1980s is considered reasonable.

The funding of a new U.S. backbone by the National Science Foundation in the 1980s, as well as private funding for other commercial backbones, led to worldwide participation in the development of new networking technologies, and the merger of many networks. Though the Internet has been widely used by academia since the 1980s, the commercialization of what was by the 1990s an international network resulted in its popularization and incorporation into virtually every aspect of modern human life. As of June 2012, more than 2.4 billion people—over a third of the world's human population—have used the services of the Internet; approximately 100 times more people than were using it in 1995. Internet use grew rapidly in the

West from the mid-1990s to early 2000s and from the late 1990s to present in the developing world. In 1994 only 3% of American classrooms had the Internet while by 2002 92% did.

The Internet has no centralized governance in either technological implementation or policies for access and usage; each constituent network sets its own policies. Only the overreaching definitions of the two principal name spaces in the Internet, the Internet Protocol address space and the Domain Name System, are directed by a maintainer organization, the Internet Corporation for Assigned Names and Numbers (ICANN). The technical underpinning and standardization of the core protocols (IPv4 and IPv6) is an activity of the Internet Engineering Task Force (IETF), a non-profit organization of loosely affiliated international participants that anyone may associate with by contributing technical expertise.

# Contents:

# Terminology

The *Internet*, referring to the specific global system of interconnected IP networks, is a proper noun and written with an initial capital letter. In the media and common use it is often not capitalized, viz. *the internet*. Some guides specify that the word should be capitalized when used as a noun, but not capitalized when used as a verb or an adjective. The Internet is also often referred to as *the Net*.

Historically the word *internet* was used, uncapitalized, as early as 1883 as a verb and adjective to refer to interconnected motions. Starting in the early 1970s the term *internet* was used as a shorthand form of the technical term internetwork, the result of interconnecting computer networks with special gateways or routers. It was also used as a verb meaning to connect together, especially for networks.

The terms *Internet* and *World Wide Web* are often used interchangeably in everyday speech; it is common to speak of "going on the Internet" when invoking a web browser to view web pages. However, the Internet is a particular global computer network connecting millions of computing devices; the World Wide Web is just one of many services running on the Internet. The Web is a collection of interconnected documents (web pages) and other web resources, linked by hyperlinks and URLs. In addition to the Web, a multitude of other services are implemented over the Internet, including e-mail, file transfer, remote computer control, newsgroups, and online games. All of these services can be implemented on any intranet, accessible to network users.

The term *Interweb* is a portmanteau of *Internet* and *World Wide Web* typically used sarcastically to parody a technically unsavvy user.

# History

Professor Leonard Kleinrock with the first ARPANET Interface Message Processors at UCLA

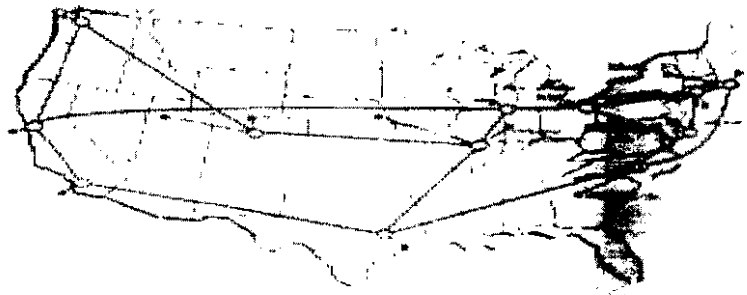
Research into packet switching started in the early 1960s and packet switched networks such as Mark I at NPL in the UK, ARPANET, CYCLADES, Merit Network, Tymnet, and Telenet, were developed in the late 1960s and early 1970s using a variety of protocols. The ARPANET in particular led to the development of protocols for internetworking, where multiple separate networks could be joined together into a network of networks.

The first two nodes of what would become the ARPANET were interconnected between Leonard Kleinrock's Network Measurement Center at the UCLA's School of Engineering and Applied Science and Douglas Engelbart's NLS system at SRI International (SRI) in Menlo Park, California, on 29 October 1969. The third site on the ARPANET was the Culler-Fried Interactive Mathematics center at the University of California at Santa Barbara, and the fourth was the University of Utah Graphics Department. In an early sign of future growth, there were already fifteen sites connected to the young ARPANET by the end of 1971. These early years were documented in the 1972 film Computer Networks: The Heralds of Resource Sharing.

Early international collaborations on ARPANET were sparse. For various political reasons, European developers were concerned with developing the X.25 networks. Notable exceptions were the *Norwegian Seismic Array* (NORSAR) in June 1973, followed in 1973 by Sweden with satellite links to the Tanum Earth Station and Peter T. Kirstein's research group in the UK, initially at the Institute of Computer Science, University of London and later at University College London.

In December 1974, *RFC 675 – Specification of Internet Transmission Control Program*, by Vinton Cerf, Yogen Dalal, and Carl Sunshine, used the term *internet* as a shorthand for *internetworking* and later RFCs repeat this use. Access to the ARPANET was expanded in 1981 when the National Science Foundation (NSF) developed the Computer Science Network (CSNET). In 1982, the Internet Protocol Suite (TCP/IP) was standardized and the concept of a world-wide network of fully interconnected TCP/IP networks called the Internet was introduced.

**NSFNET T3 Network 1992**



T3 NSFNET Backbone, c. 1992

TCP/IP network access expanded again in 1986 when the National Science Foundation Network (NSFNET) provided access to supercomputer sites in the United States from research and education organizations, first at 56 kbit/s and later at 1.5 Mbit/s and 45 Mbit/s. Commercial Internet service providers (ISPs) began to emerge in the late 1980s and early 1990s. The ARPANET was decommissioned in 1990. The Internet was fully commercialized in the U.S. by 1995 when NSFNET was decommissioned, removing the last restrictions on the use of the Internet to carry commercial traffic. The Internet started a rapid expansion to Europe and Australia in the mid to late 1980s and to Asia in the late 1980s and early 1990s.

Since the mid-1990s the Internet has had a tremendous impact on culture and commerce, including the rise of near instant communication by email, instant messaging, Voice over Internet Protocol (VoIP) "phone calls", two-way interactive video calls, and the World Wide Web with its discussion forums, blogs, social networking, and online shopping sites. Increasing amounts of data are transmitted at higher and higher speeds over fiber optic networks operating at 1-Gbit/s, 10-Gbit/s, or more.

**Worldwide Internet users**

| | 2005 | 2010 | 2013[a] |
|---|---|---|---|
| **World population** | 6.5 billion | 6.9 billion | 7.1 billion |
| **Not using the Internet** | 84% | 70% | 61% |
| **Using the Internet** | 16% | 30% | 39% |
| **Users in the developing world** | 8% | 21% | 31% |
| **Users in the developed world** | 51% | 67% | 77% |

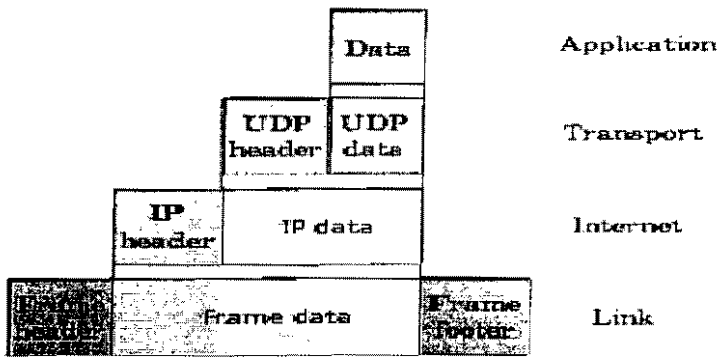
[a] Estimate.

Source: International Telecommunications Union.[204]

The Internet continues to grow, driven by ever greater amounts of online information and knowledge, commerce, entertainment and social networking. During the late 1990s, it was estimated that traffic on the public Internet grew by 100 percent per year, while the mean annual growth in the number of Internet users was thought to be between 20% and 50%. This growth is often attributed to the lack of central administration, which allows organic growth of the network, as well as the non-proprietary open nature of the Internet protocols, which encourages vendor interoperability and prevents any one company from exerting too much control over the network. As of 31 March 2011, the estimated total number of Internet users was 2.095 billion (30.2% of world population). It is estimated that in 1993 the Internet carried only 1% of the information flowing through two-way telecommunication, by 2000 this figure had grown to 51%, and by 2007 more than 97% of all telecommunicated information was carried over the Internet.

# Technology

## Protocols




As the user data is processed down through the protocol stack, each layer adds an encapsulation at the sending host. Data is transmitted "over the wire" at the link level, left to right. The encapsulation stack procedure is reversed by the receiving host. Intermediate relays remove and add a new link encapsulation for retransmission, and inspect the IP layer for routing purposes.

The communications infrastructure of the Internet consists of its hardware components and a system of software layers that control various aspects of the architecture. While the hardware can often be used to support other software systems, it is the design and the rigorous standardization process of the software architecture that characterizes the Internet and provides the foundation for its scalability and success. The responsibility for the architectural design of the Internet software systems has been delegated to the Internet Engineering Task Force (IETF). The IETF conducts standard-setting work groups, open to any individual, about the various aspects of Internet architecture. Resulting discussions and final standards are published in a series of publications, each called a Request for Comments (RFC), freely available on the IETF web site.

The principal methods of networking that enable the Internet are contained in specially designated RFCs that constitute the Internet Standards. Other less rigorous documents are simply informative, experimental, or historical, or document the best current practices (BCP) when implementing Internet technologies.

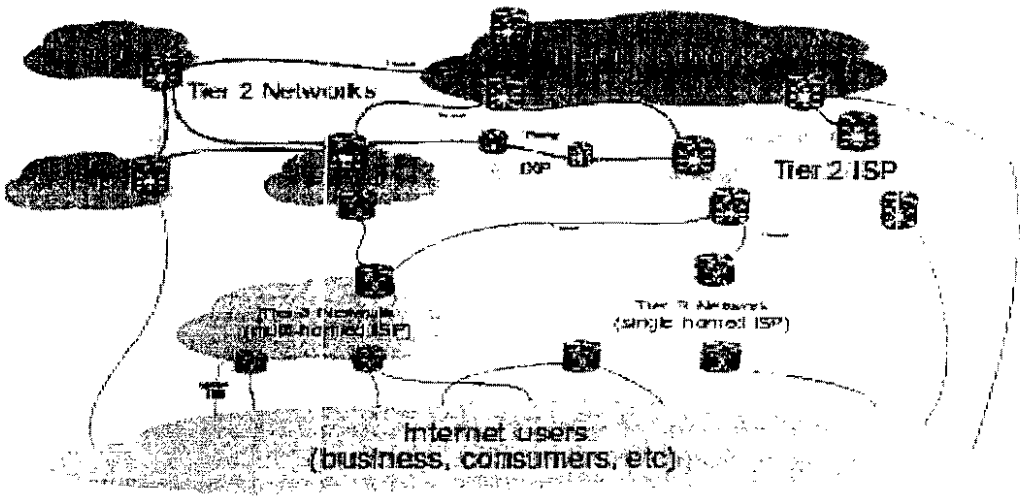
The Internet standards describe a framework known as the Internet protocol suite. This is a model architecture that divides methods into a layered system of protocols (RFC 1122, RFC 1123). The layers correspond to the environment or scope in which their services operate. At the top is the application layer, the space for the application-specific networking methods used in software applications, e.g., a web browser program uses the client-server application model and many file-sharing systems use a peer-to-peer paradigm. Below this top layer, the transport layer connects applications on *different hosts* via the network with appropriate data exchange methods. Underlying these layers are the core networking technologies, consisting of two layers.

The internet layer enables computers to identify and locate each other via Internet Protocol (IP) addresses, and allows them to connect to one another via intermediate (transit) networks. Last, at the bottom of the architecture, is a software layer, the link layer, that provides connectivity between hosts on the same local network link, such as a local area network (LAN) or a dial-up connection. The model, also known as TCP/IP, is designed to be independent of the underlying hardware, which the model therefore does not concern itself with in any detail. Other models have been developed, such as the Open Systems Interconnection (OSI) model, but they are not compatible in the details of description or implementation; many similarities exist and the TCP/IP protocols are usually included in the discussion of OSI networking.

The most prominent component of the Internet model is the Internet Protocol (IP), which provides addressing systems (IP addresses) for computers on the Internet. IP enables internetworking and in essence establishes the Internet itself. IP Version 4 (IPv4) is the initial version used on the first generation of today's Internet and is still in dominant use. It was designed to address up to ~4.3 billion ($10^9$) Internet hosts. However, the explosive growth of the Internet has led to IPv4 address exhaustion, which entered its final stage in 2011, when the global address allocation pool was exhausted. A new protocol version, IPv6, was developed in the mid-1990s, which provides vastly larger addressing capabilities and more efficient routing of Internet traffic. IPv6 is currently in growing deployment around the world, since Internet address registries (RIRs) began to urge all resource managers to plan rapid adoption and conversion.

IPv6 is not interoperable with IPv4. In essence, it establishes a parallel version of the Internet not directly accessible with IPv4 software. This means software upgrades or translator facilities are necessary for networking devices that need to communicate on both networks. Most modern computer operating systems already support both versions of the Internet Protocol. Network infrastructures, however, are still lagging in this development. Aside from the complex array of physical connections that make up its infrastructure, the Internet is facilitated by bi- or multi-lateral commercial contracts (e.g., peering agreements), and by technical specifications or protocols that describe how to exchange data over the network. Indeed, the Internet is defined by its interconnections and routing policies.

## Routing




Internet packet routing is accomplished among various tiers of Internet service providers.

Internet service providers connect customers, which represent the bottom of the routing hierarchy, to customers of other ISPs via other higher or same-tier networks. At the top of the routing hierarchy are the Tier 1 networks, large telecommunication companies which exchange traffic directly with all other Tier 1 networks via peering agreements. Tier 2 networks buy Internet transit from other providers to reach at least some parties on the global Internet, though they may also engage in peering. An ISP may use a single upstream provider for connectivity, or implement multihoming to achieve redundancy. Internet exchange points are major traffic exchanges with physical connections to multiple ISPs.

Computers and routers use routing tables to direct IP packets to the next-hop router or destination. Routing tables are maintained by manual configuration or by routing protocols. End-nodes typically use a default route that points toward an ISP providing transit, while ISP routers use the Border Gateway Protocol to establish the most efficient routing across the complex connections of the global Internet.

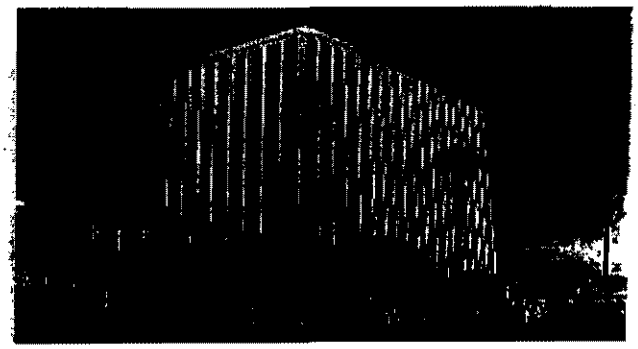
Large organizations, such as academic institutions, large enterprises, and governments, may perform the same function as ISPs, engaging in peering and purchasing transit on behalf of their internal networks. Research networks tend to interconnect into large subnetworks such as GEANT, GLORIAD, Internet2, and the UK's national research and education network, JANET.

### General structure

The Internet structure and its usage characteristics have been studied extensively. It has been determined that both the Internet IP routing structure and hypertext links of the World Wide Web are examples of scale-free networks.

Many computer scientists describe the Internet as a "prime example of a large-scale, highly engineered, yet highly complex system". The Internet is heterogeneous; for instance, data transfer rates and physical characteristics of connections vary widely. The Internet exhibits "emergent phenomena" that depend on its large-scale organization. For example, data transfer rates exhibit temporal self-similarity. The principles of the routing and addressing methods for traffic in the Internet reach back to their origins in the 1960s when the eventual scale and popularity of the network could not be anticipated. Thus, the possibility of developing alternative structures is investigated. The Internet structure was found to be highly robust to random failures and very vulnerable to high degree attacks.

## Governance



ICANN headquarters in Marina Del Rey, California, United States

The Internet is a globally distributed network comprising many voluntarily interconnected autonomous networks. It operates without a central governing body.

The technical underpinning and standardization of the Internet's core protocols (IPv4 and IPv6) is an activity of the Internet Engineering Task Force (IETF), a non-profit organization of loosely affiliated international participants that anyone may associate with by contributing technical expertise.

To maintain interoperability, the principal name spaces of the Internet are administered by the Internet Corporation for Assigned Names and Numbers (ICANN), headquartered in Marina del Rey, California. ICANN is the authority that coordinates the assignment of unique identifiers for use on the Internet, including domain names, Internet Protocol (IP) addresses, application port numbers in the transport protocols, and many other parameters. Globally unified name spaces, in which names and numbers are uniquely assigned, are essential for maintaining the global reach

of the Internet. ICANN is governed by an international board of directors drawn from across the Internet technical, business, academic, and other non-commercial communities. ICANN's role in coordinating the assignment of unique identifiers distinguishes it as perhaps the only central coordinating body for the global Internet.

Allocation of IP addresses is delegated to Regional Internet Registries (RIRs):

- African Network Information Center (AfriNIC) for Africa
- American Registry for Internet Numbers (ARIN) for North America
- Asia-Pacific Network Information Centre (APNIC) for Asia and the Pacific region
- Latin American and Caribbean Internet Addresses Registry (LACNIC) for Latin America and the Caribbean region
- Réseaux IP Européens - Network Coordination Centre (RIPE NCC) for Europe, the Middle East, and Central Asia

The National Telecommunications and Information Administration, an agency of the United States Department of Commerce, continues to have final approval over changes to the DNS root zone.[42][43][44]

The Internet Society (ISOC) was founded in 1992, with a mission to *"assure the open development, evolution and use of the Internet for the benefit of all people throughout the world"*. Its members include individuals (anyone may join) as well as corporations, organizations, governments, and universities. Among other activities ISOC provides an administrative home for a number of less formally organized groups that are involved in developing and managing the Internet, including: the Internet Engineering Task Force (IETF), Internet Architecture Board (IAB), Internet Engineering Steering Group (IESG), Internet Research Task Force (IRTF), and Internet Research Steering Group (IRSG).

On 16 November 2005, the United Nations-sponsored World Summit on the Information Society, held in Tunis, established the Internet Governance Forum (IGF) to discuss Internet-related issues.

# Modern uses

The Internet allows greater flexibility in working hours and location, especially with the spread of unmetered high-speed connections. The Internet can be accessed almost anywhere by numerous means, including through mobile Internet devices. Mobile phones, datacards, handheld game consoles and cellular routers allow users to connect to the Internet wirelessly. Within the limitations imposed by small screens and other limited facilities of such pocket-sized devices, the services of the Internet, including email and the web, may be available. Service providers may restrict the services offered and mobile data charges may be significantly higher than other access methods.

Educational material at all levels from pre-school to post-doctoral is available from websites. Examples range from CBeebies, through school and high-school revision guides and virtual universities, to access to top-end scholarly literature through the likes of Google Scholar. For distance education, help with homework and other assignments, self-guided learning, whiling away spare time, or just looking up more detail on an interesting fact, it has never been easier for people to access educational information at any level from anywhere. The Internet in general and the World Wide Web in particular are important enablers of both formal and informal education.

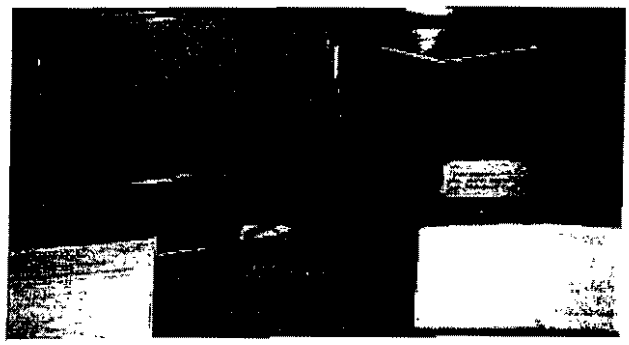
The low cost and nearly instantaneous sharing of ideas, knowledge, and skills has made collaborative work dramatically easier, with the help of collaborative software. Not only can a group cheaply communicate and share ideas but the wide reach of the Internet allows such groups more easily to form. An example of this is the free software movement, which has produced, among other things, Linux, Mozilla Firefox, and OpenOffice.org. Internet chat, whether using an IRC chat room, an instant messaging system, or a social networking website, allows colleagues to stay in touch in a very convenient way while working at their computers during the day. Messages can be exchanged even more quickly and conveniently than via email. These systems may allow files to be exchanged, drawings and images to be shared, or voice and video contact between team members.

Content management systems allow collaborating teams to work on shared sets of documents simultaneously without accidentally destroying each other's work. Business and project teams can share calendars as well as documents and other information. Such collaboration occurs in a wide variety of areas including scientific research, software development, conference planning, political activism and creative writing. Social and political collaboration is also becoming more widespread as both Internet access and computer literacy spread.

The Internet allows computer users to remotely access other computers and information stores easily, wherever they may be. They may do this with or without computer security, i.e. authentication and encryption technologies, depending on the requirements. This is encouraging new ways of working from home, collaboration and information sharing in many industries. An accountant sitting at home can audit the books of a company based in another country, on a server situated in a third country that is remotely maintained by IT specialists in a fourth. These accounts could have been created by home-working bookkeepers, in other remote locations, based on information emailed to them from offices all over the world. Some of these things were possible before the widespread use of the Internet, but the cost of private leased lines would have made many of them infeasible in practice. An office worker away from their desk, perhaps on the other side of the world on a business trip or a holiday, can access their emails, access their data using cloud computing, or open a remote desktop session into their office PC using a secure Virtual Private Network (VPN) connection on the Internet. This can give the worker complete access to all of their normal files and data, including email and other applications, while away from the office. It has been referred to among system administrators as the Virtual Private Nightmare, because it extends the secure perimeter of a corporate network into remote locations and its employees' homes.

# Services

## World Wide Web



This NeXT Computer was used by Tim Berners-Lee at CERN and became the world's first Web server.

Many people use the terms *Internet* and *World Wide Web*, or just the *Web*, interchangeably, but the two terms are not synonymous. The World Wide Web is only one of hundreds of services used on the Internet. The Web is a global set of documents, images and other resources, logically interrelated by hyperlinks and referenced with Uniform Resource Identifiers (URIs). URIs symbolically identify services, servers, and other databases, and the documents and resources that they can provide. Hypertext Transfer Protocol (HTTP) is the main access protocol of the World Wide Web. Web services also use HTTP to allow software systems to communicate in order to share and exchange business logic and data.

World Wide Web browser software, such as Microsoft's Internet Explorer, Mozilla Firefox, Opera, Apple's Safari, and Google Chrome, lets users navigate from one web page to another via hyperlinks embedded in the documents. These documents may also contain any combination of computer data, including graphics, sounds, text, video, multimedia and interactive content that runs while the user is interacting with the page. Client-side software can include animations, games, office applications and scientific demonstrations. Through keyword-driven Internet research using search engines like Yahoo! and Google, users worldwide have easy, instant access to a vast and diverse amount of online information. Compared to printed media, books, encyclopedias and traditional libraries, the World Wide Web has enabled the decentralization of information on a large scale.

The Web has also enabled individuals and organizations to publish ideas and information to a potentially large audience online at greatly reduced expense and time delay. Publishing a web page, a blog, or building a website involves little initial cost and many cost-free services are available. Publishing and maintaining large, professional web sites with attractive, diverse and up-to-date information is still a difficult and expensive proposition, however. Many individuals and some companies and groups use *web logs* or blogs, which are largely used as easily updatable online diaries. Some commercial organizations encourage staff to communicate advice

in their areas of specialization in the hope that visitors will be impressed by the expert knowledge and free information, and be attracted to the corporation as a result.

One example of this practice is Microsoft, whose product developers publish their personal blogs in order to pique the public's interest in their work. Collections of personal web pages published by large service providers remain popular, and have become increasingly sophisticated. Whereas operations such as Angelfire and GeoCities have existed since the early days of the Web, newer offerings from, for example, Facebook and Twitter currently have large followings. These operations often brand themselves as social network services rather than simply as web page hosts.

Advertising on popular web pages can be lucrative, and e-commerce or the sale of products and services directly via the Web continues to grow.

When the Web began in the 1990s, a typical web page was stored in completed form on a web server, formatted in HTML, ready to be sent to a user's browser in response to a request. Over time, the process of creating and serving web pages has become more automated and more dynamic. Websites are often created using content management or wiki software with, initially, very little content. Contributors to these systems, who may be paid staff, members of a club or other organization or members of the public, fill underlying databases with content using editing pages designed for that purpose, while casual visitors view and read this content in its final HTML form. There may or may not be editorial, approval and security systems built into the process of taking newly entered content and making it available to the target visitors.

## Communication

Email is an important communications service available on the Internet. The concept of sending electronic text messages between parties in a way analogous to mailing letters or memos predates the creation of the Internet. Pictures, documents and other files are sent as email attachments. Emails can be cc-ed to multiple email addresses.

Internet telephony is another common communications service made possible by the creation of the Internet. VoIP stands for Voice-over-Internet Protocol, referring to the protocol that underlies all Internet communication. The idea began in the early 1990s with walkie-talkie-like voice applications for personal computers. In recent years many VoIP systems have become as easy to use and as convenient as a normal telephone. The benefit is that, as the Internet carries the voice traffic, VoIP can be free or cost much less than a traditional telephone call, especially over long distances and especially for those with always-on Internet connections such as cable or ADSL. VoIP is maturing into a competitive alternative to traditional telephone service. Interoperability between different providers has improved and the ability to call or receive a call from a traditional telephone is available. Simple, inexpensive VoIP network adapters are available that eliminate the need for a personal computer.

Voice quality can still vary from call to call, but is often equal to and can even exceed that of traditional calls. Remaining problems for VoIP include emergency telephone number dialing and reliability. Currently, a few VoIP providers provide an emergency service, but it is not universally available. Older traditional phones with no "extra features" may be line-powered only and operate during a power failure; VoIP can never do so without a backup power source for the phone equipment and the Internet access devices. VoIP has also become increasingly popular for gaming applications, as a form of communication between players. Popular VoIP clients for gaming include Ventrilo and Teamspeak. Modern video game consoles also offer VoIP chat features.

## Data transfer

File sharing is an example of transferring large amounts of data across the Internet. A computer file can be emailed to customers, colleagues and friends as an attachment. It can be uploaded to a website or FTP server for easy download by others. It can be put into a "shared location" or onto a file server for instant use by colleagues. The load of bulk downloads to many users can be eased by the use of "mirror" servers or peer-to-peer networks. In any of these cases, access to the file may be controlled by user authentication, the transit of the file over the Internet may be obscured by encryption, and money may change hands for access to the file. The price can be paid by the remote charging of funds from, for example, a credit card whose details are also passed – usually fully encrypted – across the Internet. The origin and authenticity of the file received may be checked by digital signatures or by MD5 or other message digests. These simple features of the Internet, over a worldwide basis, are changing the production, sale, and distribution of anything that can be reduced to a computer file for transmission. This includes all manner of print publications, software products, news, music, film, video, photography, graphics and the other arts. This in turn has caused seismic shifts in each of the existing industries that previously controlled the production and distribution of these products.

Streaming media is the real-time delivery of digital media for the immediate consumption or enjoyment by end users. Many radio and television broadcasters provide Internet feeds of their live audio and video productions. They may also allow time-shift viewing or listening such as Preview, Classic Clips and Listen Again features. These providers have been joined by a range of pure Internet "broadcasters" who never had on-air licenses. This means that an Internet-connected device, such as a computer or something more specific, can be used to access on-line media in much the same way as was previously possible only with a television or radio receiver. The range of available types of content is much wider, from specialized technical webcasts to on-demand popular multimedia services. Podcasting is a variation on this theme, where – usually audio – material is downloaded and played back on a computer or shifted to a portable media player to be listened to on the move. These techniques using simple equipment allow anybody, with little censorship or licensing control, to broadcast audio-visual material worldwide.

Digital media streaming increases the demand for network bandwidth. For example, standard image quality needs 1 Mbit/s link speed for SD 480p, HD 720p quality requires 2.5 Mbit/s, and the top-of-the-line HDX quality needs 4.5 Mbit/s for 1080p.

Webcams are a low-cost extension of this phenomenon. While some webcams can give full-frame-rate video, the picture either is usually small or updates slowly. Internet users can watch animals around an African waterhole, ships in the Panama Canal, traffic at a local roundabout or monitor their own premises, live and in real time. Video chat rooms and video conferencing are also popular with many uses being found for personal webcams, with and without two-way sound. YouTube was founded on 15 February 2005 and is now the leading website for free streaming video with a vast number of users. It uses a flash-based web player to stream and show video files. Registered users may upload an unlimited amount of video and build their own personal profile. YouTube claims that its users watch hundreds of millions, and upload hundreds of thousands of videos daily.

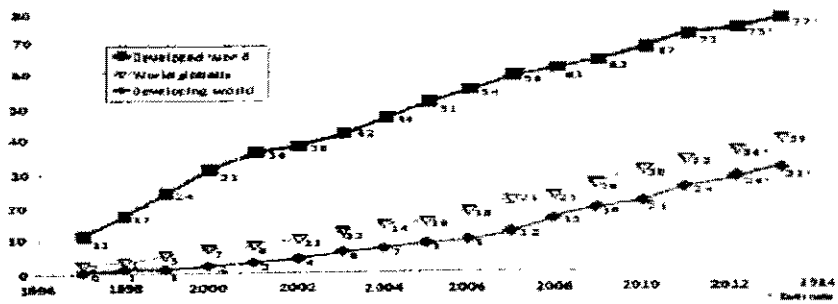
## Access

Common methods of Internet access in homes include dial-up, landline broadband (over coaxial cable, fiber optic or copper wires), Wi-Fi, satellite and 3G/4G technology cell phones. Public places to use the Internet include libraries and Internet cafes, where computers with Internet connections are available. There are also Internet access points in many public places such as airport halls and coffee shops, in some cases just for brief use while standing. Various terms are used, such as "public Internet kiosk", "public access terminal", and "Web payphone". Many hotels now also have public terminals, though these are usually fee-based. These terminals are widely accessed for various usage like ticket booking, bank deposit, online payment etc. Wi-Fi provides wireless access to computer networks, and therefore can do so to the Internet itself. Hotspots providing such access include Wi-Fi cafes, where would-be users need to bring their own wireless-enabled devices such as a laptop or PDA. These services may be free to all, free to customers only, or fee-based. A hotspot need not be limited to a confined location. A whole campus or park, or even an entire city can be enabled.

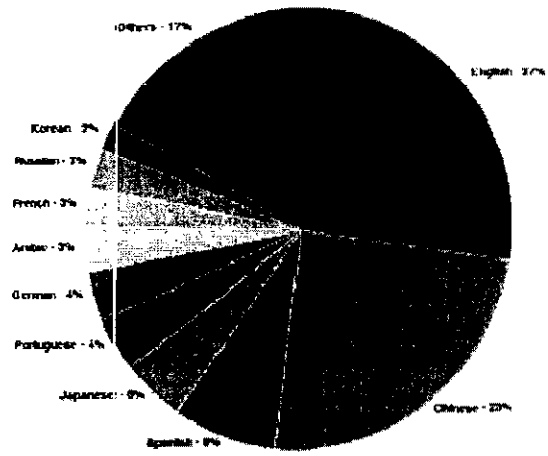
Grassroots efforts have led to wireless community networks. Commercial Wi-Fi services covering large city areas are in place in London, Vienna, Toronto, San Francisco, Philadelphia, Chicago and Pittsburgh. The Internet can then be accessed from such places as a park bench. Apart from Wi-Fi, there have been experiments with proprietary mobile wireless networks like Ricochet, various high-speed data services over cellular phone networks, and fixed wireless services. High-end mobile phones such as smartphones in general come with Internet access through the phone network. Web browsers such as Opera are available on these advanced handsets, which can also run a wide variety of other Internet software. More mobile phones have Internet access than PCs, though this is not as widely used. An Internet access provider and protocol matrix differentiates the methods used to get online.

An Internet blackout or outage can be caused by local signaling interruptions. Disruptions of submarine communications cables may cause blackouts or slowdowns to large areas, such as in the 2008 submarine cable disruption. Less-developed countries are more vulnerable due to a small number of high-capacity links. Land cables are also vulnerable, as in 2011 when a woman digging for scrap metal severed most connectivity for the nation of Armenia. Internet blackouts affecting almost entire countries can be achieved by governments as a form of Internet censorship, as in the blockage of the Internet in Egypt, whereby approximately 93% of networks were without access in 2011 in an attempt to stop mobilization for anti-government protests.

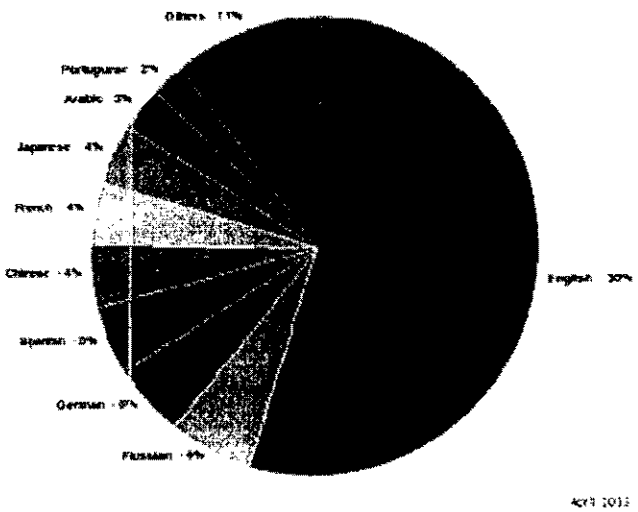
# Users




Internet users per 100 inhabitants




Internet users by language




Website content languages

Overall Internet usage has seen tremendous growth. From 2000 to 2009, the number of Internet users globally rose from 394 million to 1.858 billion. By 2010, 22 percent of the world's population had access to computers with 1 billion Google searches every day, 300 million Internet users reading blogs, and 2 billion videos viewed daily on YouTube.

The prevalent language for communication on the Internet has been English. This may be a result of the origin of the Internet, as well as the language's role as a lingua franca. Early computer systems were limited to the characters in the American Standard Code for Information Interchange (ASCII), a subset of the Latin alphabet.

After English (27%), the most requested languages on the World Wide Web are Chinese (23%), Spanish (8%), Japanese (5%), Portuguese and German (4% each), Arabic, French and Russian (3% each), and Korean (2%). By region, 42% of the world's Internet users are based in Asia, 24% in Europe, 14% in North America, 10% in Latin America and the Caribbean taken together, 6% in Africa, 3% in the Middle East and 1% in Australia/Oceania. The Internet's technologies have developed enough in recent years, especially in the use of Unicode, that good facilities are available for development and communication in the world's widely used languages. However, some glitches such as *mojibake* (incorrect display of some languages' characters) still remain.

In an American study in 2005, the percentage of men using the Internet was very slightly ahead of the percentage of women, although this difference reversed in those under 30. Men logged on more often, spent more time on the Internet and were more likely to be broadband users, whereas women tended to make more use of opportunities to communicate (such as email). Men were more likely to use the Internet to pay bills, participate in auctions, and for recreation such as downloading music and videos. Men and women were equally likely to use the Internet for shopping and banking. More recent studies indicate that in 2008, women significantly outnumbered men on most social networking sites, such as Facebook and Myspace, although the ratios varied with age. In addition, women watched more streaming content, whereas men downloaded more. In terms of blogs, men were more likely to blog in the first place; among those who blog, men were more likely to have a professional blog, whereas women were more likely to have a personal blog.

According to Euromonitor, by 2013 [illegible] of the world's population will be users of the Internet. Splitting by country, in 2011 Iceland, Norway and the Netherlands had the highest Internet penetration by the number of users, with more than 90% of the population with access.

# Social impact

The Internet has enabled entirely new forms of social interaction, activities, and organizing, thanks to its basic features such as widespread usability and access.

## Social networking and entertainment

Many people use the World Wide Web to access news, weather and sports reports, to plan and book vacations and to find out more about their interests. People use chat, messaging and email to make and stay in touch with friends worldwide, sometimes in the same way as some previously had pen pals. The Internet has seen a growing number of Web desktops, where users can access their files and settings via the Internet.

Social networking websites such as Facebook, Twitter, and MySpace have created new ways to socialize and interact. Users of these sites are able to add a wide variety of information to pages, to pursue common interests, and to connect with others. It is also possible to find existing acquaintances, to allow communication among existing groups of people. Sites like LinkedIn foster commercial and business connections. YouTube and Flickr specialize in users' videos and photographs.

The Internet has been a major outlet for leisure activity since its inception, with entertaining social experiments such as MUDs and MOOs being conducted on university servers, and humor-related Usenet groups receiving much traffic. Today, many Internet forums have sections devoted to games and funny videos; short cartoons in the form of Flash movies are also popular. Over 6 million people use blogs or message boards as a means of communication and for the sharing of ideas. The Internet pornography and online gambling industries have taken advantage of the World Wide Web, and often provide a significant source of advertising revenue for other websites. Although many governments have attempted to restrict both industries' use of the Internet, in general this has failed to stop their widespread popularity.

Another area of leisure activity on the Internet is multiplayer gaming. This form of recreation creates communities, where people of all ages and origins enjoy the fast-paced world of multiplayer games. These range from MMORPG to first-person shooters, from role-playing video games to online gambling. While online gaming has been around since the 1970s, modern modes of online gaming began with subscription services such as GameSpy and MPlayer. Non-subscribers were limited to certain types of game play or certain games. Many people use the Internet to access and download music, movies and other works for their enjoyment and relaxation. Free and fee-based services exist for all of these activities, using centralized servers and distributed peer-to-peer technologies. Some of these sources exercise more care with respect to the original artists' copyrights than others.

Internet usage has been correlated to users' loneliness. Lonely people tend to use the Internet as an outlet for their feelings and to share their stories with others, such as in the "I am lonely will anyone speak to me" thread.

Cybersectarianism is a new organizational form which involves: "highly dispersed small groups of practitioners that may remain largely anonymous within the larger social context and operate in relative secrecy, while still linked remotely to a larger network of believers who share a set of practices and texts, and often a common devotion to a particular leader. Overseas supporters provide funding and support; domestic practitioners distribute tracts, participate in acts of resistance, and share information on the internal situation with outsiders. Collectively, members and practitioners of such sects construct viable virtual communities of faith, exchanging personal testimonies and engaging in collective study via email, on-line chat rooms and web-based message boards."

Cyberslacking can become a drain on corporate resources; the average UK employee spent 57 minutes a day surfing the Web while at work, according to a 2003 study by Peninsula Business Services. Internet addiction disorder is excessive computer use that interferes with daily life. Psychologist Nicolas Carr believe that Internet use has other effects on individuals, for instance improving skills of scan-reading and interfering with the deep thinking that leads to true creativity.

## Electronic business

Electronic business (E-business) involves business processes spanning the entire value chain: electronic purchasing and supply chain management, processing orders electronically, handling customer service, and cooperating with business partners. E-commerce seeks to add revenue streams using the Internet to build and enhance relationships with clients and partners.

According to research firm IDC, the size of total worldwide e-commerce, when global business-to-business and -consumer transactions are added together, will equate to $16 trillion in 2013. IDate, another research firm, estimates the global market for digital products and services at $4.4 trillion in 2013. A report by Oxford Economics adds those two together to estimate the total size of the digital economy at $20.4 trillion, equivalent to roughly 13.8% of global sales.

While much has been written of the economic advantages of Internet-enabled commerce, there is also evidence that some aspects of the Internet such as maps and location-aware services may serve to reinforce economic inequality and the digital divide. Electronic commerce may be responsible for consolidation and the decline of mom-and-pop, brick and mortar businesses resulting in increases in income inequality.

## Telecommuting

Remote work is facilitated by tools such as groupware, virtual private networks, conference calling, videoconferencing, and Voice over IP (VOIP). It can be efficient and useful for companies as it allows workers to communicate over long distances, saving significant amounts of travel time and cost. As broadband Internet connections become more commonplace, more and more workers have adequate bandwidth at home to use these tools to link their home to their corporate intranet and internal phone networks.

## Crowdsourcing

Internet provides a particularly good venue for crowdsourcing (outsourcing tasks to a distributed group of people) since individuals tend to be more open in web-based projects where they are not being physically judged or scrutinized and thus can feel more comfortable sharing.

Crowdsourcing systems are used to accomplish a variety of tasks. For example, the crowd may be invited to develop a new technology, carry out a design task, refine or carry out the steps of an algorithm, or help capture, systematize, or analyze large amounts of data.

Wikis have also been used in the academic community for sharing and dissemination of information across institutional and international boundaries. In those settings, they have been found useful for collaboration on grant writing, strategic planning, departmental documentation, and committee work. The United States Patent and Trademark Office uses a wiki to allow the public to collaborate on finding prior art relevant to examination of pending patent applications. Queens, New York has used a wiki to allow citizens to collaborate on the design and planning of a local park.

The English Wikipedia has the largest user base among wikis on the World Wide Web and ranks in the top 10 among all Web sites in terms of traffic.

## Politics and political revolutions

The Internet has achieved new relevance as a political tool. The presidential campaign of Howard Dean in 2004 in the United States was notable for its success in soliciting donation via the Internet. Many political groups use the Internet to achieve a new method of organizing in order to carry out their mission, having given rise to Internet activism, most notably practiced by rebels in the Arab Spring.

*The New York Times* suggested that social media websites, such as Facebook and Twitter, helped people organize the political revolutions in Egypt where it helped certain classes of protesters organize protests, communicate grievances, and disseminate information. The potential of the Internet as a civic tool of communicative power was thoroughly explored by Simon R. B. Berdal in his thesis of 2004:

As the globally evolving Internet provides ever new access points to virtual discourse forums, it also promotes new civic relations and associations within which communicative power may flow and accumulate. Thus, traditionally ... national-embedded peripheries get entangled into greater, international peripheries, with stronger combined powers... The Internet, as a consequence, changes the topology of the "centre-periphery" model, by stimulating conventional peripheries to interlink into "super-periphery" structures, which enclose and "besiege" several centres at once.

Berdal, therefore, extends the Habermasian notion of the Public sphere to the Internet, and underlines the inherent global and civic nature that interwoven Internet technologies provide. To limit the growing civic potential of the Internet, Berdal also notes how "self-protective measures" are put in place by those threatened by it:

If we consider China's attempts to filter "unsuitable material" from the Internet, most of us would agree that this resembles a self-protective measure by the system against the growing civic potentials of the Internet. Nevertheless, both types represent limitations to "peripheral capacities". Thus, the Chinese government tries to prevent communicative power to build up and unleash (as the 1989 Tiananmen Square uprising suggests, the government may find it wise to install "upstream measures"). Even though limited, the Internet is proving to be an empowering tool also to the Chinese periphery: Analysts believe that Internet petitions have influenced policy implementation in favour of the public's online-articulated will ...

## Philanthropy

The spread of low-cost Internet access in developing countries has opened up new possibilities for peer-to-peer charities, which allow individuals to contribute small amounts to charitable projects for other individuals. Websites, such as DonorsChoose and GlobalGiving, allow small-scale donors to direct funds to individual projects of their choice.

A popular twist on Internet-based philanthropy is the use of peer-to-peer lending for charitable purposes. Kiva pioneered this concept in 2005, offering the first web-based service to publish individual loan profiles for funding. Kiva raises funds for local intermediary microfinance organizations which post stories and updates on behalf of the borrowers. Lenders can contribute as little as $25 to loans of their choice, and receive their money back as borrowers repay. Kiva falls short of being a pure peer-to-peer charity, in that loans are disbursed before being funded by lenders and borrowers do not communicate with lenders themselves.

However, the recent spread of low cost Internet access in developing countries has made genuine international person-to-person philanthropy increasingly feasible. In 2009 the US-based nonprofit Zidisha tapped into this trend to offer the first person-to-person microfinance platform to link lenders and borrowers across international borders without intermediaries. Members can fund loans for as little as a dollar, which the borrowers then use to develop business activities that improve their families' incomes while repaying loans to the members with interest. Borrowers access the Internet via public cybercafes, donated laptops in village schools, and even smart phones, then create their own profile pages through which they share photos and information about themselves and their businesses. As they repay their loans, borrowers continue to share updates and dialogue with lenders via their profile pages. This direct web-based connection allows members themselves to take on many of the communication and recording tasks traditionally performed by local organizations, bypassing geographic barriers and dramatically reducing the cost of microfinance services to the entrepreneurs.

## Surveillance

The vast majority of computer surveillance involves the monitoring of data and traffic on the Internet. In the United States for example, under the Communications Assistance For Law Enforcement Act, all phone calls and broadband internet traffic (emails, web traffic, instant messaging, etc.) are required to be available for unimpeded real-time monitoring by Federal law enforcement agencies.

Packet capture (also sometimes referred to as "packet sniffing") is the monitoring of data traffic on a computer network. Computers communicate over the Internet by breaking up messages (emails, images, videos, web pages, files, etc.) into small chunks called "packets", which are routed through a network of computers, until they reach their destination, where they are assembled back into a complete "message" again. Packet Capture Appliance intercepts these packets as they are travelling through the network, in order to examine their contents using other programs. A packet capture is an information *gathering* tool, but not an *analysis* tool. That is it gathers "messages" but it does not analyze them and figure out what they mean. Other programs are needed to perform traffic analysis and sift through intercepted data looking for important/useful information. Under the Communications Assistance For Law Enforcement Act all U.S. telecommunications providers are required to install packet sniffing technology to allow Federal law enforcement and intelligence agencies to intercept all of their customers' broadband Internet and voice over Internet protocol (VoIP) traffic.

There is far too much data gathered by these packet sniffers for human investigators to manually search through all of it. So automated Internet surveillance computers sift through the vast amount of intercepted Internet traffic, and filter out and report to human investigators those bits of information which are "interesting"—such as the use of certain words or phrases, visiting certain types of web sites, or communicating via email or chat with a certain individual or group. Billions of dollars per year are spent, by agencies such as the Information Awareness Office, NSA, and the FBI, to develop, purchase, implement, and operate systems which intercept and analyze all of this data, and extract only the information which is useful to law enforcement and intelligence agencies.

Similar systems are now operated by Iranian secret police to identify and suppress dissidents. All required hardware and software has been allegedly installed by German Siemens AG and Finnish Nokia.

## Censorship

**Internet censorship by country**

| | |
|---|---|
| Pervasive censorship | Changing situation |
| Substantial censorship | Little or no censorship |
| Selective censorship | Not classified / no data |

Some governments, such as those of Burma, Iran, North Korea, the Mainland China, Saudi Arabia, and the United Arab Emirates restrict what people in their countries can access on the Internet, especially political and religious content. This is accomplished through software that filters domains and content so that they may not be easily accessed or obtained without elaborate circumvention.

In Norway, Denmark, Finland, and Sweden, major Internet service providers have voluntarily, possibly to avoid such an arrangement being turned into law, agreed to restrict access to sites listed by authorities. While this list of forbidden URLs is supposed to contain addresses of only known child pornography sites, the content of the list is secret. Many countries, including the United States, have enacted laws against the possession or distribution of certain material, such as child pornography, via the Internet, but do not mandate filtering software. There are many free and commercially available software programs, called content-control software, with which a user can choose to block offensive websites on individual computers or networks, in order to limit a child's access to pornographic materials or depiction of violence.

# زبان تخصصی

# اینترنت

ویژه دانشجویان مراکز علمی-کاربردی

تهیه و گردآوری:

رضا مالکی نژاد